

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Total Maximum Daily Load Information Sheet

Beef Branch

Water Body ID: 3224

Water Body Segment at a Glance:

County:	Newton
Nearby City:	Joplin
Length:	2.5 miles
Pollutants:	Cadmium (in sediment and water) Lead (in sediment) Zinc (in sediment and water)
Source:	Mill tailings

Schedule for TMDL development:

TMDL development schedules are subject to change.

The most current schedule for TMDL development is available on the department's website at dnr.mo.gov/env/wpp/tmdl/wpc-tmdl-progress.htm



Description of the Problem

A water body is considered impaired when it fails to meet applicable water quality standards. Water quality standards consist of designated uses, water quality criteria, an antidegradation policy and implementation procedures. Beef Branch is impaired due to exceedances of state water quality criteria that protect aquatic life designated uses.

Designated uses of Beef Branch*

- Warm Water Habitat (WWH)
- Whole Body Contact Recreation Category B (WBC-B)
- Secondary Contact Recreation (SCR)
- Human Health Protection (HHP)
- Irrigation (IRR)
- Livestock and Wildlife Protection (LWP)

* In addition to these specific uses, all waters of the state are protected by the general water quality criteria that are specified in the state's Water Quality Standards at 10 CSR 20-7.031(4).

Designated uses that are impaired

- Warm Water Habitat (WWH)
- General Criteria

Criteria that Apply

- Missouri Water Quality Standards for toxic substances at 10 CSR 20-7.031(5)(B)1 state:

Water contaminants shall not cause the criteria in Tables A and B to be exceeded.

Concentrations of these substances in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded.

- Table A of the Water Quality Standards contains dissolved metals criteria for the protection of aquatic life designated use (WWH). These criteria are hardness dependent and limits are calculated from the formulas shown below:

Dissolved Cadmium

$$\text{Acute}^1 = e^{(1.0166 * \ln(\text{hardness}) - 3.062490)} * (1.136672 - (\ln(\text{hardness}) * 0.041838)) = \mu\text{g/L}$$

$$\text{Chronic} = e^{(0.7409 * \ln(\text{hardness}) - 4.719948)} * (1.101672 - (\ln(\text{hardness}) * 0.041838)) = \mu\text{g/L}$$

Dissolved Zinc

$$\text{Acute} = e^{(0.8473 * \ln(\text{Hardness}) + 0.884)} * 0.98$$

$$\text{Chronic} = e^{(0.8473 * \ln(\text{Hardness}) + 0.884)} * 0.98$$

- Missouri has no numeric criteria for metals in sediment. Likewise, federal guidelines have not yet been established for toxic chemicals in stream or lake sediments. In lieu of such criteria, Probable Effect Concentrations, or PECs, suggested by McDonald, et al., are used to assess toxicity in stream sediments.² PECs are the concentrations at which some toxic effect on aquatic life is likely.
- Missouri streams are also protected by the general criteria found at 10 CSR 20-7.031(4). The particular general criteria that apply to Beef Branch include:
 - (D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life.
 - (G) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community.

Water Quality Data

The chronic and acute water quality criteria for protection of aquatic life for dissolved metals are based on the 25th percentile hardness level of the water. For Beef Branch, a hardness value of 144 mg/L was used to determine the appropriate metals criteria. A water body is judged to be impaired if chronic or acute numeric criteria are exceeded on more than one occasion during the last three years for which data is available. Dissolved cadmium and zinc data from 2010 – 2012 show three exceedances of the chronic cadmium criterion and two exceedances of the acute and chronic zinc criterion during this period (Figure 1).

¹ Acute criteria apply to short exposures to toxic conditions that aquatic creatures can survive without harm. Chronic criteria apply to conditions producing adverse effects on aquatic life or wildlife following long-term exposure but having no readily observable effect over a short time period. Chronic criteria values are typically lower than acute criteria values.

² *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*, D. MacDonald, et al., 2000. USGS

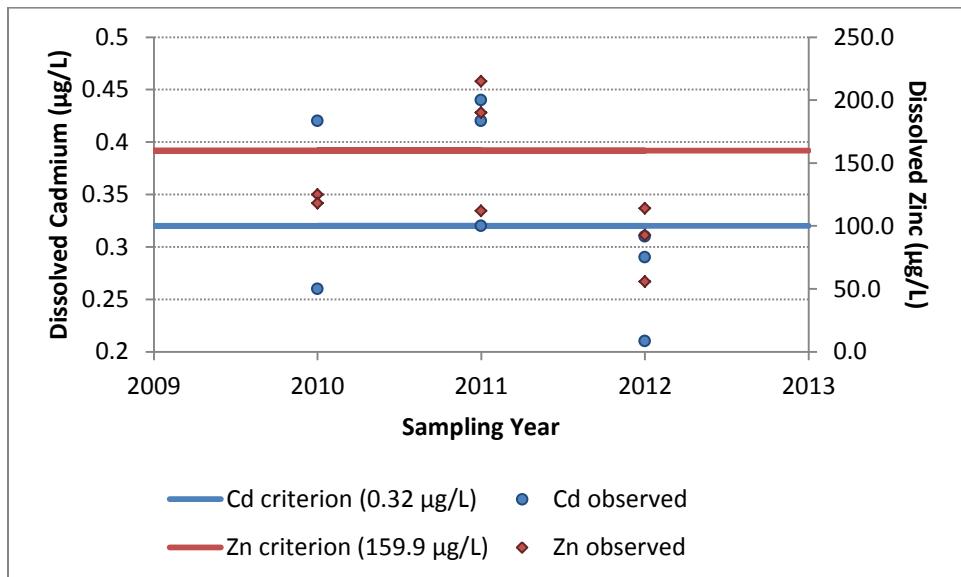


Figure 1. Dissolved cadmium (Cd) and zinc (Zn) data (2010 – 2012)

The relationship between the amount of a toxicant in sediment and the strength of the toxicity it exerts on aquatic life is not simple or straightforward. While neither Missouri nor EPA has standards or guidelines for sediment toxicity, the USGS has reviewed a large number of research papers on the subject. Based on this review, the USGS suggests numeric guidelines that could be used to judge the potential for toxicity to aquatic life. These are the PECs mentioned in the discussion of “criteria that apply.” A stream is judged to be impaired due to metals in sediment if the geometric mean of the observed data exceed the PEC value by more than 150 percent (Table 1).

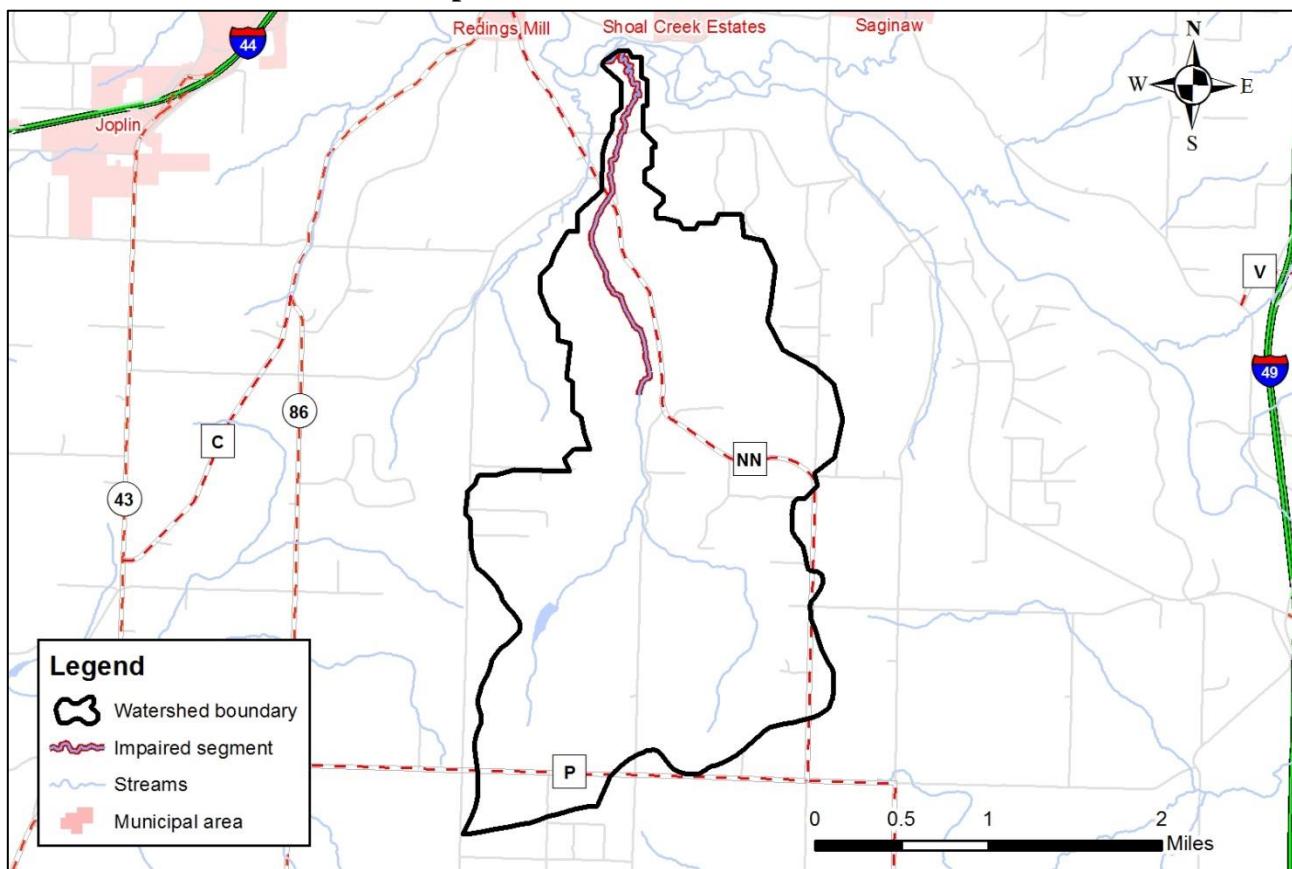
Table 1. Metals in Sediment Data for Beef Branch (data from 1986 – 2011)

Pollutant	PEC (mg/L)	Beef Branch Geometric Mean (mg/L)
Lead	128	1,499
Cadmium	4.98	81.3
Zinc	459	11,686

TMDL for Beef Branch

The Beef Branch TMDL will calculate the maximum amount of each listed pollutant that the stream can receive and still meet water quality standards. The TMDL will also identify all potential or suspected pollutant sources in the watershed and distribute the allowable pollutant loads among those various sources. When developed, the Beef Branch TMDL will use the most current and available data. For this reason, the final TMDL may present information that differs from that contained in this information sheet.

Map of the Beef Branch Watershed



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